OIL PUMP DRIVE ASSEMBLY

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention relates to an oil pump drive assembly for an automobile engine. More particularly, the invention relates to a balance shaft driven by a rotating drive shaft of an oil pump.

Description of the Related Art

[0002] Automobile engines include an oil pump for pumping oil to lubricate moving parts within the engine. Engines typically include a rotating balance shaft for dampening vibrations associated with the operation of the engine. Preferably, the balance shaft rotates at generally twice the speed of the engine. The higher rotational speed of the balance shaft is typically achieved by the use of a gear assembly coupled between the engine and the balance shaft.

[0003] It is known to drive the oil pump with the rotation of the balance shaft. Since the oil pump operates at approximately the same speed as the engine, the lower operational speed of the pump relative to the balance shaft is achieved by the use of a second gear assembly coupled between the balance shaft and the oil pump. Multiple sets of gears at each end of the balance shaft increase the costs of manufacture and inventory.

SUMMARY OF THE INVENTION

[0004] According to one aspect of the invention, an oil pump drive assembly for an automobile engine is provided. The oil pump drive assembly includes an oil pump. A drive shaft is rotatably secured to the oil pump for actuating the oil pump in response to rotation of the drive shaft. The drive shaft extends between a pump end secured to the oil pump and a

distal end. A sprocket is secured to the distal end of the drive shaft. A gear assembly including a drive gear secured to the drive shaft between the pump end and the distal end and a driven gear engaged with the drive gear for rotation of the driven gear in response to rotation of the drive shaft is provided. The gear assembly is positioned at the distal input end of the drive shaft and the oil pump is positioned at an opposite pump end of the drive shaft for providing packaging space for the oil pump drive assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0006] Figure 1A is a schematic view of the oil pump drive assembly without a balance shaft;

[0007] Figure 1B is a schematic view of the oil pump drive assembly with a balance shaft;

[0008] Figure 2 is a schematic view of a conventional oil pump drive assembly; and

[0009] Figure 3 is an exploded perspective view of the oil pump drive assembly with a balance shaft.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] Referring to Figures 1 and 3, an oil pump drive assembly for an automotive engine is generally indicated at 10. The oil pump drive assembly 10 includes a housing 11. A drive shaft 12 extending between a sprocket end 14 and a pump end 16 is journaled to the housing 11. A sprocket gear 18 is fixedly secured to the sprocket end 14 of the drive shaft 12. The sprocket gear 18 is rotatably driven by an engine driven chain, belt and the like to cause rotation of the drive shaft 12. A pump 20 is coupled to the pump end 16 of the drive shaft 12

for actuating the pump 20 in response to rotation of the drive shaft 12. In a first embodiment of the invention shown in Figure 1A, the oil pump drive assembly 10 does not include a balance shaft, as will be discussed in more detail below with reference to a second embodiment. As can be seen, the pump 20 is positioned at a rear or distal end of the drive shaft 12 to allow for packaging space for the oil pump 20 in a congested engine compartment of a vehicle. Preferably, the pump 20 comprises a gerotor type pump having a pump stator 70, pump gerotor 71, pump valve body 72, pump valve spring 73, and pump valve plug 74 disposed within a pump housing 58, as best seen in Figure 3.

[0011] A second embodiment of the oil pump drive assembly 10 of the present invention is shown in Figures 1B and 3. A drive gear 22 is fixedly secured to the drive shaft 12 between the sprocket end 14 and the pump end 16. The drive gear 22 rotates with the drive shaft 12.

[0012] A balance shaft 24, generally parallel to the drive shaft 12, extends between a gear end 26 and a distal end 28. The balance shaft 24 is journaled to the housing 11. A driven gear 30 is fixedly secured to the gear end 26 of the balance shaft 24. The driven gear 30 is engaged with the drive gear 22 to cause rotation of the balance shaft 24 in response to rotation of the drive shaft 12. Preferably, the driven gear 30 has a smaller diameter than that of the drive gear 22 so that the balance shaft 24 rotates at a higher speed than the drive shaft 12.

[0013] The housing 11 includes a sprocket side 32 and a pump side 40. The sprocket side 32 extends between an upper end 34 and a lower end 36. The pump side 40 extends between an upper end 42 and a lower end 44. A base 46 extends between the lower ends 36, 44 of the sprocket 32 and pump 40 sides, respectively. A first bore 48 is formed in the sprocket side 32 for supporting the gear end 26 of the balance shaft 24 therethrough. A second bore 50 is formed in the pump side 34 for supporting the distal end 28 of the balance shaft 24

therethrough. The first 48 and second 50 bores define a first axis 52. The balance shaft 24 rotates about the first axis 52.

[0014] A tube 54 is secured to the upper end 36 of the sprocket side 32 of the housing 11. A cylindrical third bore 56 is defined by the tube 54 for supporting the sprocket end 14 of the drive shaft 12. A pump housing 58 is secured to the upper end 42 of the pump side 40 of the housing 11. A fourth bore 60 is formed in the pump housing 58 for supporting the pump end 16 of the drive shaft 12. The third 56 and fourth 60 bores define a second axis 62. The drive shaft 12 rotates about the second axis 62. The pump 20 is enclosed in the pump housing 58 which is attached to the housing 11.

[0015] In operation, the sprocket gear 18 is operatively driven by the engine. The sprocket gear 18 rotates the drive shaft 12. The pump 20 is actuated by the rotation of the drive shaft 12. The drive shaft 12 also rotates with the drive gear 22. In a preferred aspect, the driven gear 30 and balance shaft 24 rotate together in response to the rotation of the drive gear 22. The driven gear 30 and balance shaft 24 rotate together at a higher speed relative to the drive shaft 12 due to the smaller diameter of the driven gear 30 relative to the drive gear 22. The pump 20 operates generally at the same speed as the engine due to the direct connection of the pump 20 to the drive shaft 12.

[0016] For comparative purposes, a conventional oil pump drive assembly for an automobile engine is generally indicated at 110 in Figure 3. The conventional oil pump drive assembly 110 includes a balance shaft 112 extending longitudinally between an input end 114 and an output end 116. A driven gear 118 is secured to the input end 114. A rear drive gear 120 is secured to the output end 116. A drive gear 122 is engaged with the driven gear 118 for rotating the driven gear 118 and the balance shaft 112 in response to rotation of the drive gear 122. A first shaft 124 extends axially between a drive gear end 126 secured to the drive gear 122 and a sprocket end 128. A sprocket 130 is fixedly secured to the sprocket end 128 of the

first shaft 124. A rear driven gear 132 is engaged with the rear drive gear 120 for rotation of the rear driven gear 132 in response to rotation of the balance shaft 112. A second shaft 134 extends axially between a driven gear end 136 secured to the rear driven gear 132 and a pump end 138. A pump 140 is coupled to the pump end 138 of the second shaft 134 for actuation of the pump 140 in response to rotation of the rear driven gear 132.

[0017] In operation, the sprocket 130 is rotatably driven by the engine. The drive gear 122 rotates with the sprocket 130, which causes rotation of the driven gear 118. The balance shaft 112 and the rear drive gear 120 rotate together with the driven gear 118. The rear driven gear 132, driven by the rear drive gear 120, rotates in response to the rotation of the balance shaft 112. The pump 140 is driven by the rotation of the rear driven gear 132.

[0018] The driven gear 118 has a diameter that is smaller than that of the drive gear 122, such that the balance shaft 112 rotates at a higher speed than the engine. Similarly, the rear driven gear 132 has a diameter that is larger than the rear drive gear 120. The pump 140, although driven by the balance shaft 112, operates generally at the same speed as the engine. Thus, the conventional oil pump drive assembly 110 utilizes at least four gears 118, 120, 122, 132 to drive the balance shaft 112 and the pump 140 at the desired operating speeds with respect to the operating speed of the engine. In contrast, the oil pump drive assembly 10 of the present invention utilizes only two gears 22, 30 to achieve the differing operating speeds of the balance shaft 24 and the pump 20 with respect to the operating speed of the engine.

[0019] The invention has been described in an illustrative manner, and it is to be understood that the terminology, which has been used, is intended to be in the nature of words of description rather than of limitation.

[0020] Many modification and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced other than as specifically described.